Acoustic Emission Monitoring of Prestressed Girders During Fabrication and Transport

Robert Worley, Dryver Huston, Mandar Dewoolkar,
Tian Xia, Dylan Burns, Robert Farrell, Daniel Orfeo and Mauricio Pereira

Project Background

Prefabricated and pre-stressed concrete bridge girders often suffer from cracking, with majority of the cracks appearing as diagonal cracks at the ends (Fig. 1). These cracks are generally unlikely to be of structural concern, but may pose aesthetic and serviceability issues. This project focuses on developing reusable instrumentation and monitoring technology for prestressed concrete girders during fabrication and transport.

Figure 1. Inclined and Horizontal End Cracking on Girder (Photograph by Concrete Bridge Views)

Operating Principles and Instrumentation

An Acoustic Emission is a transient elastic wave produced in a solid by the release of stored elastic energy or redistribution of stresses caused by a wide variety of sources such as loading, pressure changes, temperature changes, or chemical reaction processes (Figs. 3 & 4). The instrumentation was an 8-channel Mistras Sensor Highway III with 60 Hz low power sensors (Fig. 2).

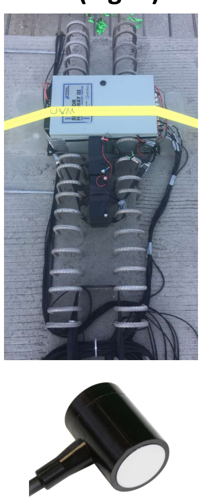
Figure 2. MISTRAS Sensor Highway III

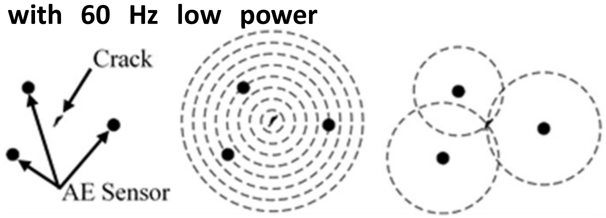

Figure 3. Elastic Acoustic Emission Wave Propagation

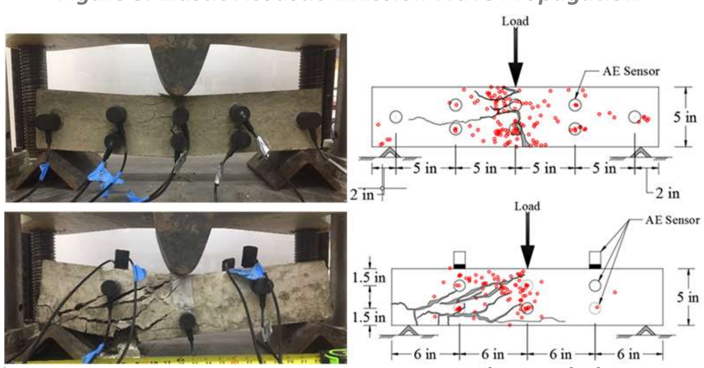

Figure 4. Sensor Array on Concrete Beams and Recorded AE Events

Data Collection and Analysis

AE data collection was performed on laboratory beams (Fig. 4), Northeast Extreme Tee (NEXT) beams, and Northeast Bulb Tee (NEBT) girders. Field tests were performed during 1) detensioning (Fig. 5) 2) craned lifting, and 3) transport (Figs. 6, 7 & 8).

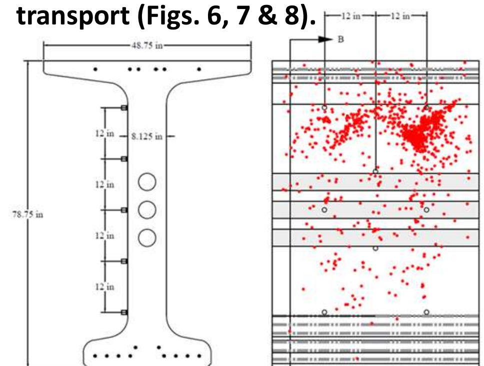
Figure 5. Transport Midspan of Straight Section

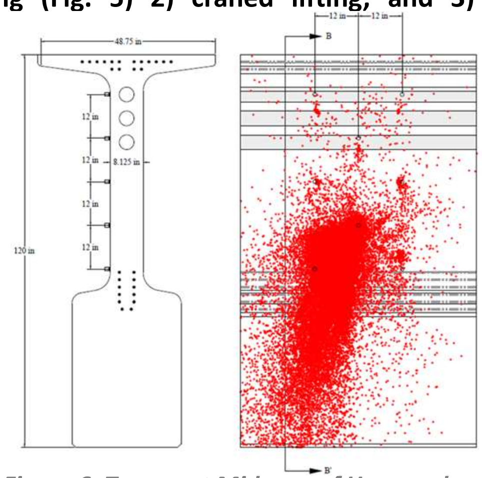
Figure 6. Transport Midspan of Hammerhead

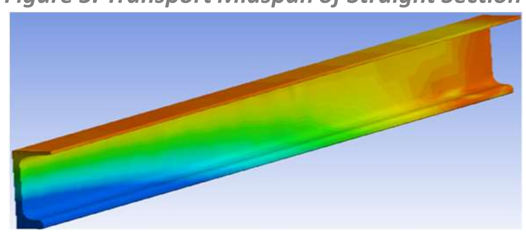
Figure 7. Finite Element Modeling


Figure 8. Transport Testing

Conclusions and Future Work

Laboratory and field results indicate the viability of AE sensing technology for monitoring prefabricated concrete girders during fabrication and transport. If successful the technique could be extended to monitoring girders during installation and in-service of the bridge, and future QA/QC efforts.

Future work includes additional data collection to develop a more complete AE signature catalogue for the development of specific accept/reject criteria for AE sensing as a QA/QC procedure.

Acknowledgments

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